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ABSTRACT

A series of studies demonstrates that preschool, preoperational children deal effectively with tasks by anticipating the likelihood of their success and failure. They manifest these expectations in their behavior: in their decision time for making predictions, in the distributions of these predictions, and in their approach to particular tasks. They are also able to make explicit certainty or expectancy statements when they are allowed to express what they know behaviorally. Preschool children use other information in a way similar to that used by school-age children and adults. Furthermore, they are influenced by a kind of motivational bias, anticipating more successes than seem warranted, especially for high levels of difficulty. Similar biases, however, have been observed in adults, especially when a response mode was used for which reality constraints were not strong. In general, results suggest a more positive view of young children's abilities to anticipate their future performance than that which has been held by other investigators of achievement behavior in children. Accounting for this outcome is the fact that tasks were used which enabled children to capitalize on their experience outside the laboratory and which tried to tap children's understanding by nonverbal methods. Nineteen references and 10 figures are provided. (RH)

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Cognitive task and task-outcome evaluations in preschooler's achievement-striving*

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1. Introduction

The understanding of probabilistic factors in the causation of action outcomes in human behavior, and the separation of stable and unstable causes in the person and in the environment, demands cognitive skills not yet achieved by preschool children (Heckhausen, 1982; Nicholls, 1978, 1980). Not before children have mastered a concept of "normative difficulty", i.e. the understanding that tasks are more difficult and demand more ability if fewer individuals succeed at them, will they be able to separate difficulty of a task per se and their own skills with the task as the essential factors for future task outcome. According to Nicholls (1978, 1980) only concrete-operational but not preoperational children demonstrate a beginning differentiation between these factors, an understanding which might still develop until adolescence. In keeping with this view Parson & Ruble (1977) demonstrated that only children who were 7 years and older made realistic, outcome-dependent assessments of their success chances in a puzzle task, in which they had experienced success and failures.

However, we have shown over the last years that children do not need this mature understanding of the causation of outcomes and also do not need a fully developed concept of subjective success probability in order to choose intermediate difficulty

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levels, i.e., to do calculated risk-taking sensu Atkinson and Lewin. Children at this age have an intuitive understanding of the certainty or uncertainty of a coming success or failure in tasks with which they have had some experience (or at least had some experience with similar tasks) and can use this analog of success expectancy to choose tasks which are neither to difficult nor to easy for them.

Similar discrepancies have been observed in a related area of research, the study of the development of the "proportionality scheme", which was considered to be the basis of probability estimates in lottery games by Piaget & Inhelder (1951). According to these authors only formal-operational adolescents will be able to perform new operations on the results of operations (proportions) in order to come to probability estimates. However, several studies which tapped children's understanding with non-verbal methods, demonstrated at least a working understanding of the probability of chance events in elementary school and even preschool children (see Brainerd (1978) and Siegel (1982) for reviews).

2. Some empirical findings

We did not agree with Parsons & Ruble's (1977) conclusion that children between 3;6 and 5 years are not able to make realistic assessments of the success chances on the basis of previous success and failure experiences. Parsons & Ruble had asked the children to rate on a six-point scale their success probabilities for a coming trial. Thus, children's subjective probabilities were inferred from verbal behavior which is necessarily based on a conceptual representation of the difficulty of the task and demands verbal skills preschool children generally do not have (Siegel, 1978).

Children's intuitive understanding of the difficulty of tasks may become manifest in different behaviors but may not be translatable into verbal statements. Therefore, we gave our children (1) tasks with objective difficulty cues - for example, the distance from a basket in a ball-throwing task or the volume of a box in a lifting task or the width of a gap in a marble-rolling task. In addition, we gave children in most studies (2) a possibility to experience success and failure with these tasks and allowed them (3) to express their certainty for future task outcomes behaviorally. Children were asked, in order to indicate the number of trials at which they thought they might succeed in coming trials, to divide differently coloured tennis or ping-pong balls into two boxes, a success box or a failure box, or to move beads on an abacus-like instrument from the left to the right.

Aside from these nonverbally measured expectations for future successes, we assessed different behavioral indicators of subjective uncertainty. The first measurement was decision time, i.e., the time subjects needed to predict a success or a failure, and later, approach time was measured, too, i.e., the time subjects needed to approach a task. For both measures, children were unaware that they were being timed. Disappointingly, in our first studies with preschool children (Schneider, 1984), average decision time did not discriminate between different task difficulty levels in the marble-rolling and ball-throwing tasks. However, as mentioned before, even children at this age are able to estimate their chances realistically with the help of the nonverbal assessment procedures mentioned above. The following figures show the averaged subjective probabilities in two different tasks, a ball-throwing and a marble-rolling task, over several age groups between 3 1/2 and 6 1/2 years (figures 1 and 2). Children overestimate the lower chances somewhat, a phenomenon

observed in older subjects as well. With increasing age they become more and more realistic. Stipek and associates (see Stipek, 1984) have found evidence that this optimism, characteristic for preschoolers' success expectancies, is an expression of stronger wishful thinking and not so much an expression of an inability to process task outcome information.

In the marble-rolling task in which children had rolled marbles through gaps of different width at the end of a playing table, such age differences did not become manifest in the non-verbally assessed success probabilities but rather only in the greater proportions of yes-answers of the younger children. Thus, preschoolers' optimism with respect to future task outcome seems less general than has been claimed before. It depends on the assessment procedure and obviously also on the task and, presumably, on the amount of experience a child has with a task or at least with similar tasks. In order to test this hypothesis we used a task in subsequent studies with which preschoolers and even toddlers have extensive experience in their home and in nursery school.

This task was a box-lifting task in which children had to indicate, from a series of differently sized boxes, whether they would be able to lift a box or not. Here, also the decision time needed to say "yes" or "no" and, in addition, the speed in approaching the boxes in order to lift them, differentiated between the task difficulty levels (Unzner & Schneider, 1991). In the first study with this task we assessed the prognostic skills of 30 preschoolers between 3 and 6 years of age. Children were set in the middle of a semicircle with 5 boxes which increased in size from 10x10x10 cm to 60x60x60 cm and were arranged in a random order; the experimenter pointed with a rod to one of the

five boxes. Children then had to indicate verbally or nonverbally whether they would be able to lift the box or not. The next figure shows the proportions of "yes", "no" and "I don't know"-answers, the average decision times and also the number of eye fixations coded from a video recording (fig. 3). Children needed longest to answer to the experimenter's success question at the second largest box (53x53x53 cm). For this box the distribution of of "yes"-, "no"- and "I don't know"-answers indicates also a maximum of uncertainty in this sample of preschoolers. In addition, children also walked faster to middle-sized boxes than to the largest and smallest one, the approach-speed being probably an indicator of their task motivation. (fig. 4).

What might be the advantage of such a box-lifting task compared to a ball-throwing or marble-rolling task? Children at 3 1/2 years and older have probably experienced in their natural environment many more chances to lift objects than to throw balls or roll marbles. But the fact that the boxes were presented simultaneously might have also given them an advantage over the successive presentation of distances in the ball-throwing task and gates of different width in the marble-rolling task. Yet, lately we observed that a successive presentation of the boxes, the boxes were shown one after the other from behind a curtain, did not make a difference in the behavioral discrimination of the difficulty levels in this task (Schneider, Hanne, & Lehmann, in prep.) The next figure shows the averaged decision times (dt) for three age groups, the 3, 4, and 5-year-olds, as well as the proportions of "yes"-, "no"- and "I don't know"-answers. For dt, both conditions, successive and simultaneous, are combined because there were no differences between them (fig. 5). Again, as in the first study, children walk increasingly faster to middle-sized boxes in order to lift them (fig. 6).

Even children between the ages of 2 and 3 years demonstrate with this task (only 4 boxes) for which they had no experience at all an impressively good understanding of the difficulty structure of four differently sized boxes and a realistic assessment of their success chances (Unzner & Schneider, 1984, study II). In this study the two to three-year-olds (C1 - C3) were confronted 3 times with the 4 boxes at 3 month intervals (T1 - T3). From the second period of observation, at which the youngest children (C1)had reached an age of 2;3, children differentiate clearly in the success predictions ($p < .01$) between the four differently sized boxes (fig. 7). We even observed differences in the decision time children needed in order to make their predictions for the four boxes (fig. 8). Children from the two oldest age groups (C2, C3)needed increasingly more time to make their prediction the larger the box was ($p < .01$, respectively $p < .05$). This may be interpretated as a manifestation of an even greater optimism of toddlers as compared to preschoolers for this task.

We assumed that toddlers and preschool children have more experience with object-lifting than with marble-rolling or ball-throwing and have already stabilized frames of references for volume-weight relations (see Mounoud & Hauert, 1982). Thus, children do not even need success and failure experiences in order to predict realistically their ability to lift such a box when they can generalize from their record of experience with similar tasks. We had not given them a chance to experience this task; all predictions were made simply on the basis of the appearance of the boxes. With new tasks, especially tasks which are unlike those tasks a child has had experience with, children will need additional information in order to form realistic expectan-

cies for future task outcomes. The most valid information is based on children's own experience with the task. However, other information - objective task properties or successes or failures of a model with the same task - are used by children also.

Although it has been demonstrated that preschoolers are neither interested nor efficiently able to use social norm information (see Veroff, 1969; Ruble, Boggiano, Feldman, & Loeble, 1980), they will consider the outcomes of another child with the same task, when this information is available, in order to form expectations for their own performance. We observed this recently in an unpublished study in which preschool children could observe other preschoolers in a video clip who either were or were not successful at a task. The task involved trying to bring a little playmobile figure with an elevator to the first, second or third floor of a playhouse. The elevator was suspended in front of the house with a string and could be moved with a crank. A success model had 6, 4 and 3 successes out of 6 trials on the 3 different floors;, a failure model 3, 1 and 0 successes. In a third condition no model was presented. Subjects were 43 (21 f and 22 m) children between the ages of 3 1/2 and 6 1/2 years. Children had to estimate their success chances for each floor before they were give a chance to play the game themselves. Figure 9 presents the average estimates for a coming success for each floor and the proportions of success predictions for the three age groups. Children demonstrate an understanding of the three difficulty levels ($p < .01$). There are differences for this effect between the three age groups which, however, are not significant.

The observation of a failure model dampens success expectancies in all children compared to the observation of a success model or no model at all ($p < .05$ in each case). We conclude that, although children may not be interested in social norms for

specific task performances, they can use the performance results of an appropriate model effectively as an additional cue for the evaluation of the difficulty of a task which they have not yet tried.

Our observations demonstrate that preschool and, consequently, preoperational children are dealing effectively with the task by anticipating future success and failure. They manifest these expectations in their behavior: in their decision time for making predictions, in the distributions of these predictions and also in their approach speed to the task. However, they are also able to make explicit certainty or expectancy statements when they are allowed to express what they know behaviorally. They use, in addition, other information in a way similar to school-age children and adults. They are influenced by a kind of motivational bias, anticipating more successes than seem waranted, especially for high difficulty levels. Similar biases, however, have been observed in adults, especially when a response mode was used, for which reality constrains were not strong (Schneider, 1972). Thus, we come to a more positive view of young children's abilities to anticipate their own future performance than other students of achievement behavior in children. We think that the reason for this is the fact that we used tasks for which children could capitalize on their experience outside the laboratory and that we tried to tap children's understanding by nonverbal methods.

3. A model of the information storage and processing units involved in success expectations.

It still remains true that it will take many years before children will master a full understanding of outcome causation with compensation between different causal factors and the probabilistic elements therein. However, when talking about this mature

understanding of success probabilities and the intuitive working understanding of preschoolers we are really talking about different phenomena. Only when we consider the different mechanisms of information processing and information storage presumably involved e.g. in the probability estimates of a preschooler on the basis of his or her own experience with the tasks, and the probability estimates of adolescence youth taking into account the intricacies of causation of an outcome, will we be able to clarify the contradictory results and conclusions.

Following Brainerd (1981) I assume that children have different storage and processing mechanisms at their disposal in order to form an expectation depending on their cognitive level, the experience with the task or similar tasks, and the information given. The more basic way of processing action outcome information is by the registration of the number of trials with a given task and the proportions of successes and failures. Registers which increase by one step with each of these events will do this job (fig. 10).There is evidence in the literature that for children the storage of frequency information of events is an obligatory process (see Ghatala, Levin, & Truman, 1978).

When children are confronted with a task for which they have extensive experience, either with the same or similar tasks, all they need to do is to retrieve this information from the long term store (LTS). This is the most valid information a person can rely upon in an achievement situation and, therefore, such retrieved information might supersede all other possible influences, also motivational biasing dispositions: Egocentric distortions of the world will be finally given up even by young children in order to form more realistic notions. - When children are confronted with a completely new task, for which generalization from other similar tasks is not possible, they have to rely on

their short term store (STS) when they are given the opportunity to try the task. The storage and retrieval from STS might be more open to motivational influences than the retrieval from the stabilized LTS. In addition, the capacity of the STS and of other processing units might limit children's performance. Finally, when subjects are confronted with tasks which they have not yet experienced but are given only social norms, they have to rely on higher forms of causal reasoning which they are not able to do even until the end of the concrete-operational stage. Therefore, attribution theorists are right in their assumption that expectations on the basis of such information is a late achievement in the development of children (Heckhausen, 1982; Nicholls & Miller, 1983, 1984). However, they are wrong in arguing that, in order to form expectations, children have to be in this stage of cognitive development. Children have other mechanisms at their disposal at younger ages. Even when adolescents or adults had experience with a task or were given a chance to try a task, they will fall back on the more basic forms of information processing and storage usage. It has been shown countless times by students of achievement motivation (e.g.,Feather, 1966), that adults are rather indifferent to social norms and wait until they have made their own experience with the task before they give more extreme expectancy statements.

Coming to an end I hope that I was successful in convincing you that we will promote our understanding of the development of achievement motivation in children, especially of the way children deal with task information and performance feedback, only when we specify explicit and developmental models of the mechanisms for information processing and storage in achievement-oriented behavior. Such models will help us to formulate better

questions than the simple-minded questions we have asked so far: whether children can do this or not at a particular age.

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Figure 1

Ball-Throwing

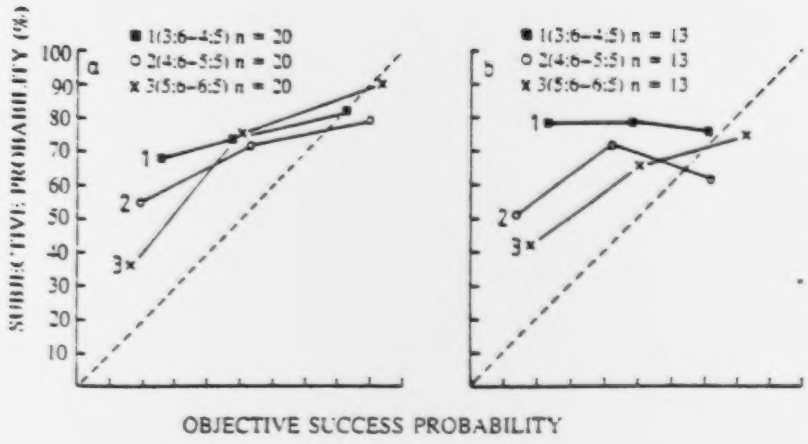


Figure 2

Marble-Rolling

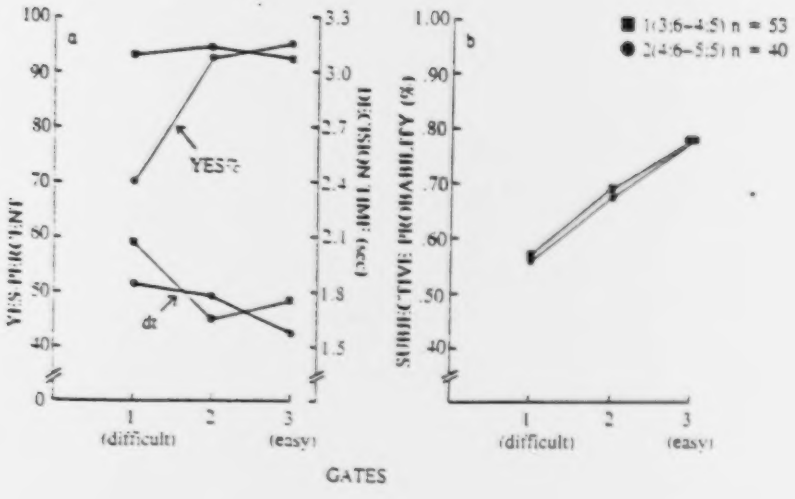


Figure 3

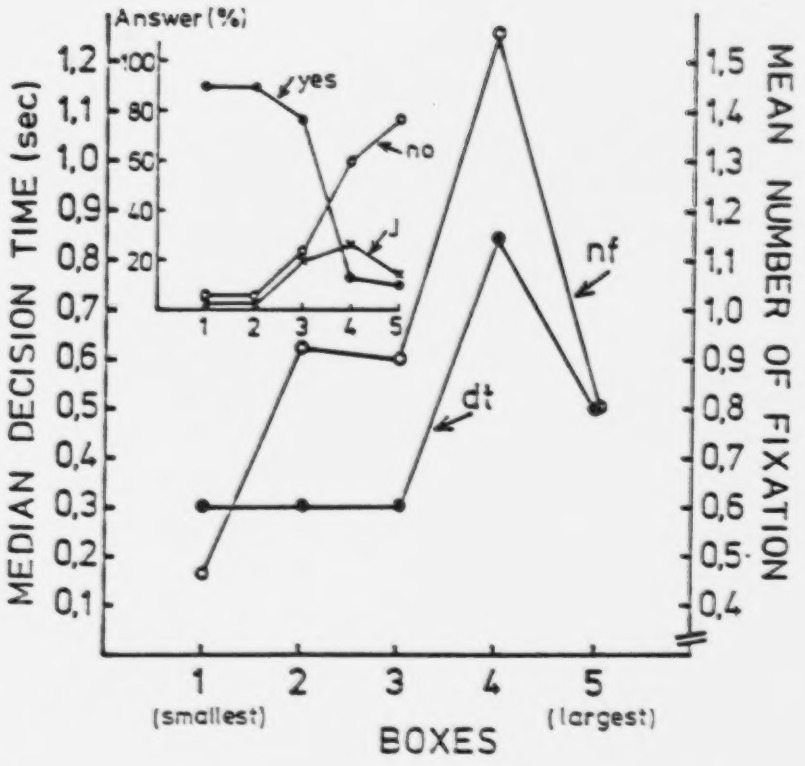
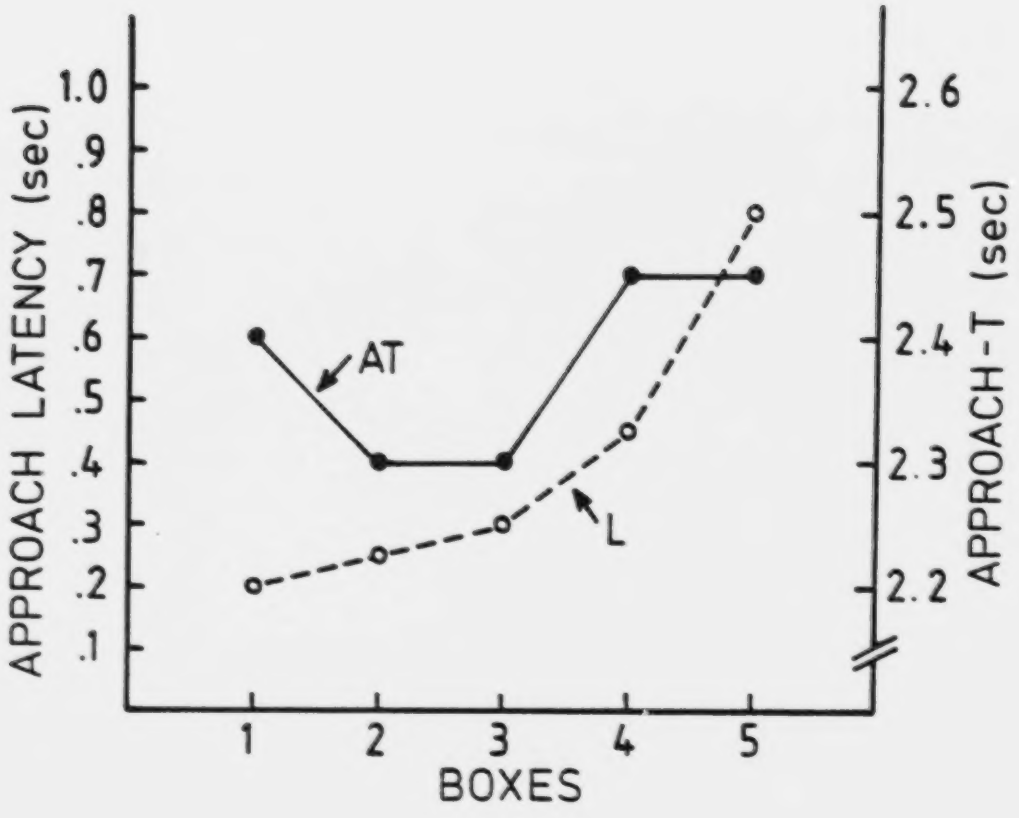
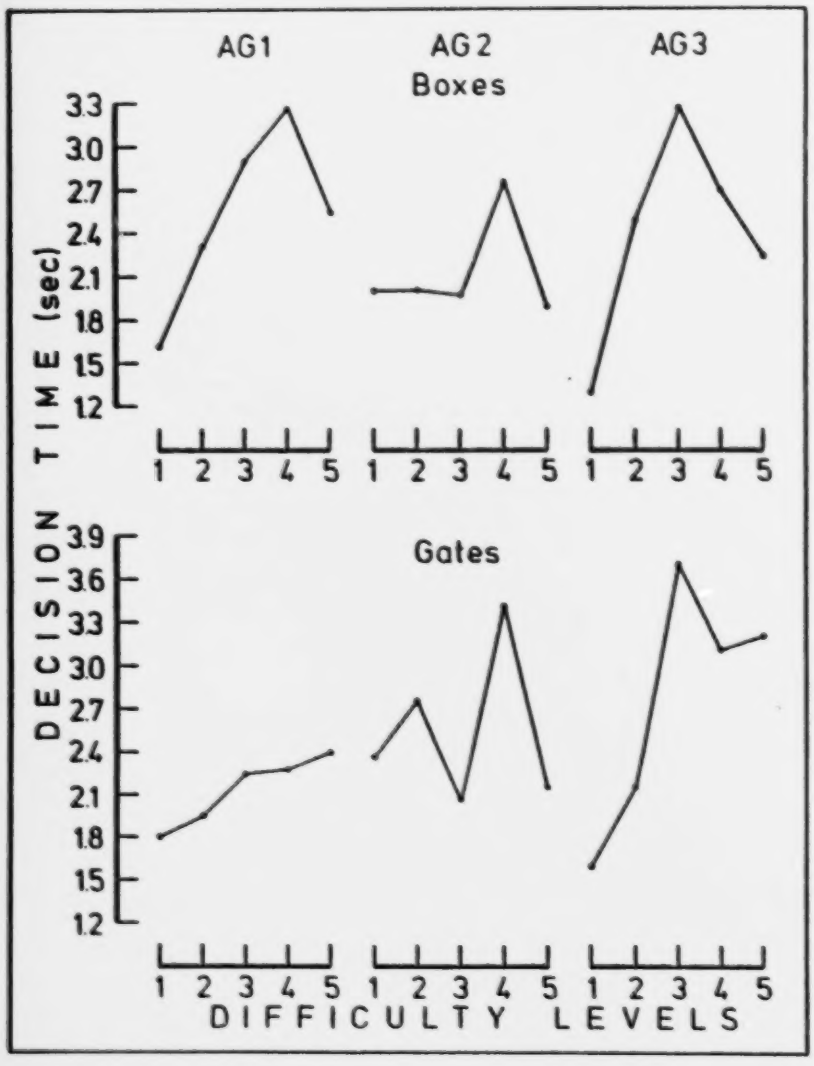

Answer (%)
yes
no
J
nf
dt
MEDIAN DECISION TIME (sec)
MEAN NUMBER OF FIXATION
1 (smallest)
2
3
4
5 (largest)
BOXES

Figure 4


APPROACH LATENCY (sec)
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
AT
L
2.6
2.5
2.4
2.3
2.2
APPROACH-T (sec)
1
2
3
4
5
BOXES


AG1
AG2
AG3
Boxes
DECISION TIME (sec)
3.3
3.0
2.7
2.4
2.1
1.8
1.5
1.2
1 2 3 4 5
Gates
3.9
3.6
3.3
3.0
2.7
2.4
2.1
1.8
1.5
1.2
DIFFICULTY LEVELS

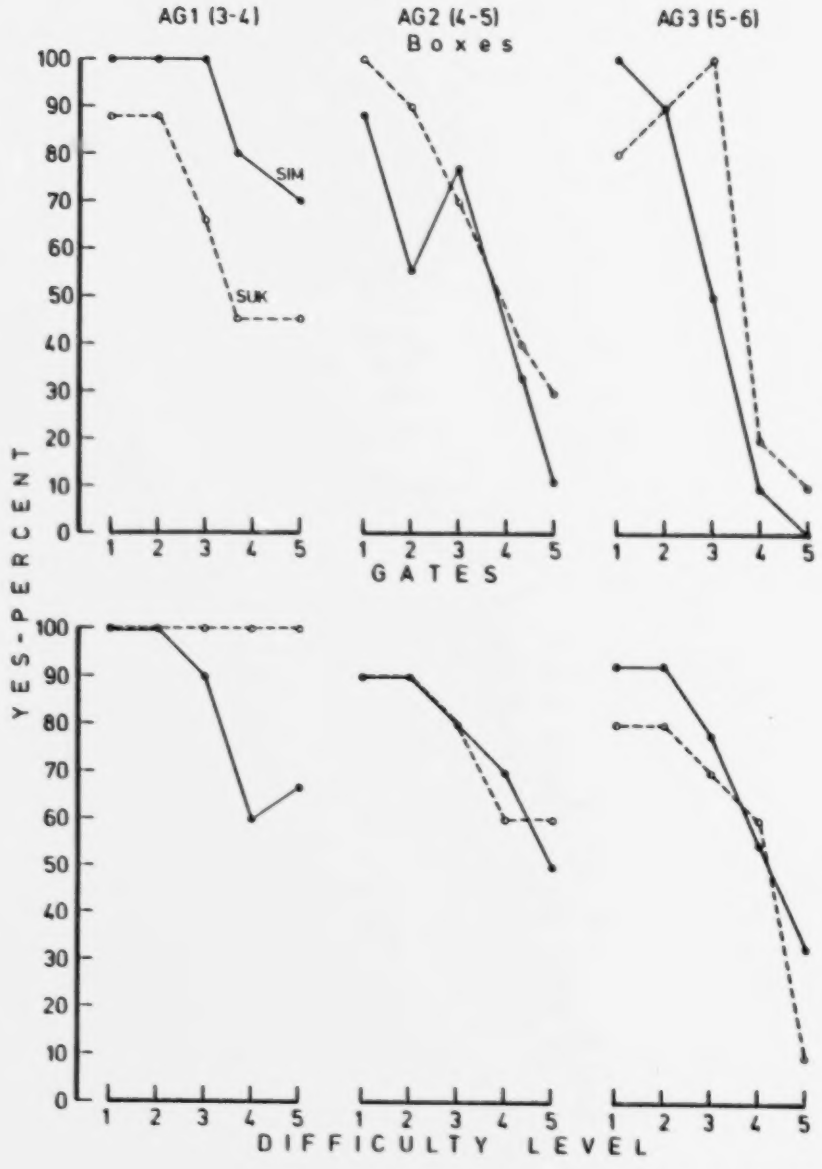

AG1 (3-4)
AG2 (4-5)
AG3 (5-6)
Boxes
SIM
SUK
YES-PERCENT
100
90
80
70
60
50
40
30
20
10
0
1 2 3 4 5
GATES
DIFFICULTY LEVEL

Figure 5

Figure 6

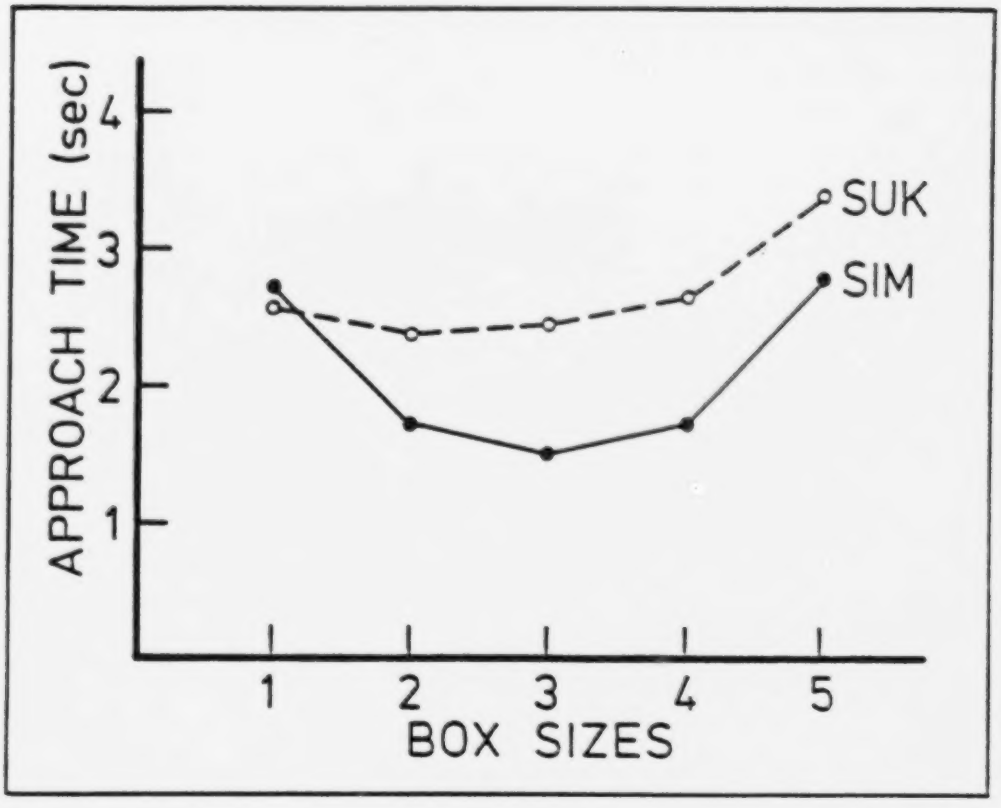
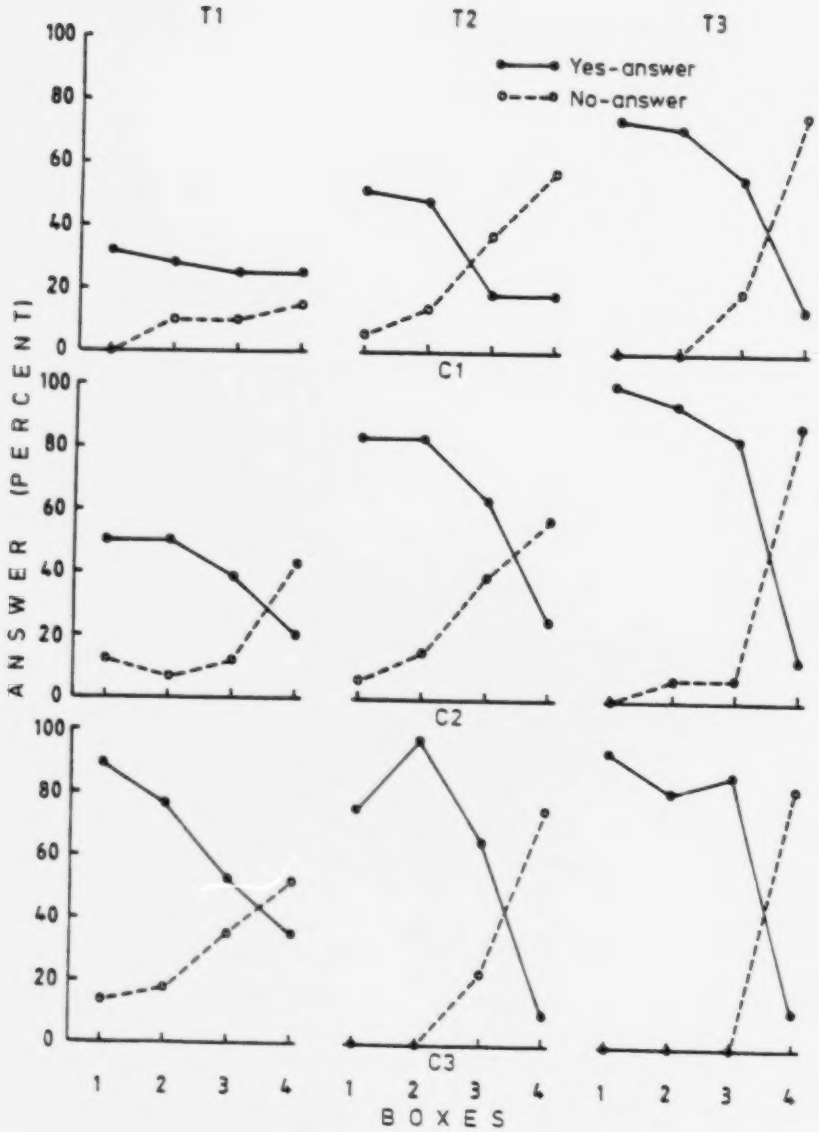


Figure 7


T1
T2
T3
Yes-answer
No-answer
ANSWER (PERCENT)
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80
60
40
20
0
C1
C2
C3
1
2
3
4
BOXES

Figure 8

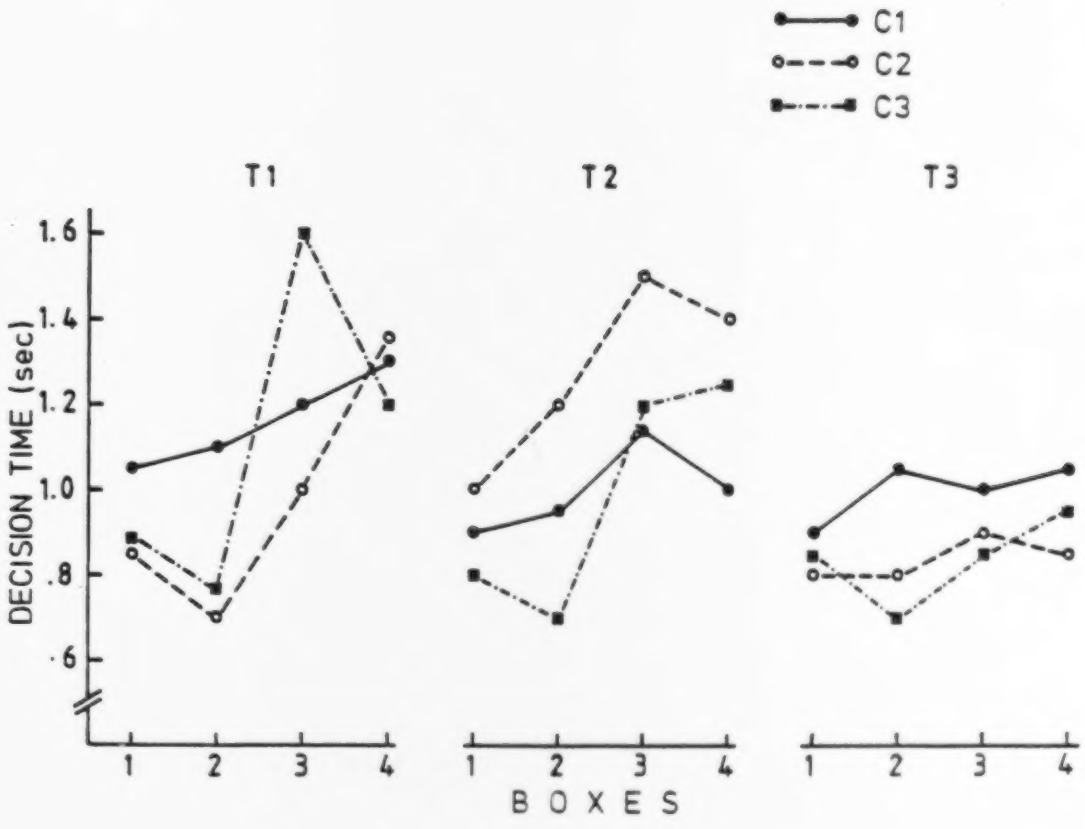
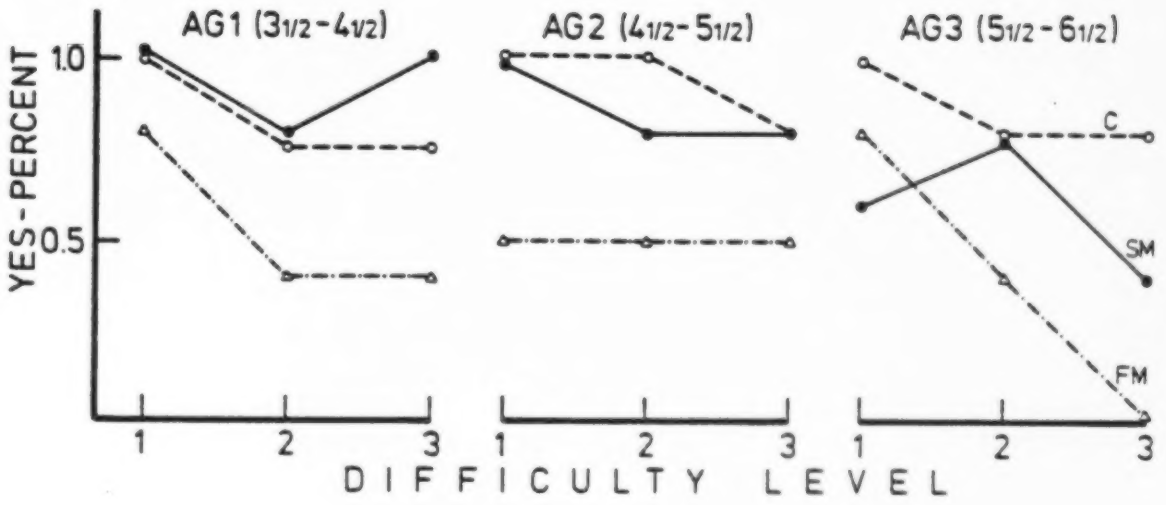


Figure 9


AG1 (3½-4½)
AG2 (4½-5½)
AG3 (5½-6½)
YES-PERCENT
1.0
0.5
C
SM
FM
1
2
3
DIFFICULTY LEVEL

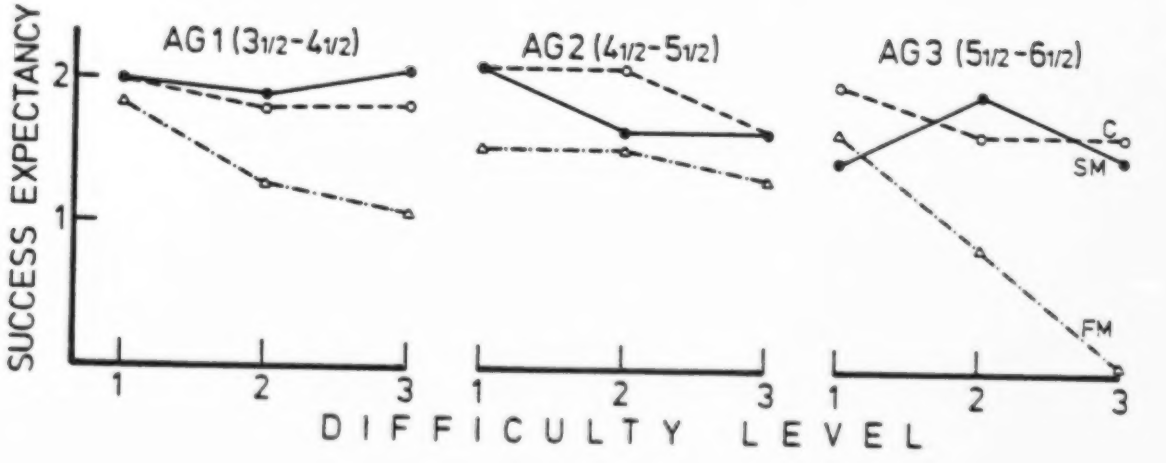
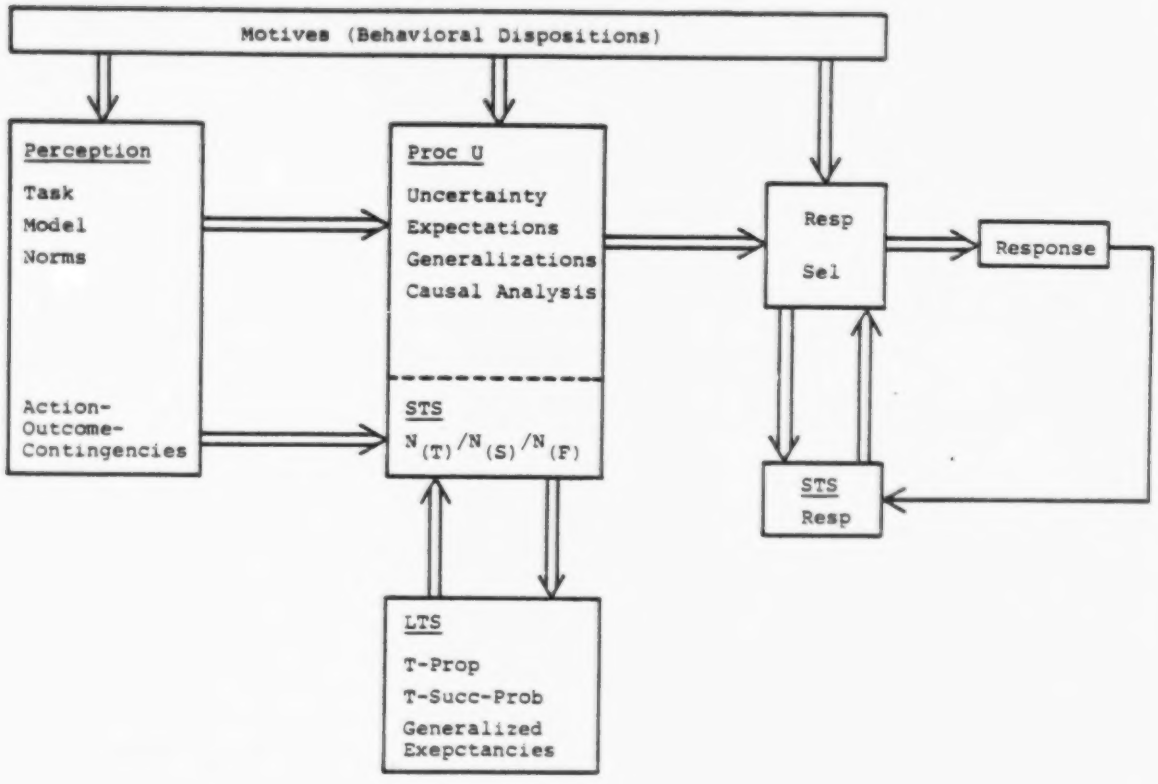

AG1 (3½-4½)
AG2 (4½-5½)
AG3 (5½-6½)
SUCCESS EXPECTANCY
2
1
C
SM
FM
1
2
3
DIFFICULTY LEVEL

Figure 10


Motives (Behavioral Dispositions)
Perception
Task
Model
Norms
Action-
Outcome-
Contingencies
Proc U
Uncertainty
Expectations
Generalizations
Causal Analysis
STS
N(T)/N(S)/N(F)
Resp
Sel
Response
STS
Resp
LTS
T-Prop
T-Succ-Prob
Generalized
Exepctancies